Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices	)	
	)	ET Docket No. 99-231
Wi-LAN, Inc Application for Certification of an Intentional Radiator Under Part 15 of The Commission's Rules	)	DA 00-2317

COMMENTS OF TEXAS INSTRUMENTS

Texas Instruments Incorporated ("TI") submits these comments in response to the Further Notice of Proposed Rulemaking in the above-captioned proceeding, FCC 01-158, released May 11, 2001.

Summary of Position

For frequency hopping devices at 2450 MHz, TI supports the Commission's proposal to allow the use of as few as 15 hopping channels with a power limit of 125 mW. While we agree that adaptive hopping provides benefits, we believe that adaptive hopping should be encouraged but should not be mandatory.

TI generally supports the Commission's proposal to establish a category of Digital Transmission System (DTS) devices under Part 15, and to impose only a limit on output power and power density that assures no greater interference than allowed by existing spread spectrum rules. However, the specific proposal to retain the power spectral density limit of 8 dBm per 3 kHz (equivalent to 33 dBm or 2 Watts per 1 MHz) may in fact produce substantial interference and should be modified. Either 100 mW per 1 MHz, comparable to existing Direct Sequence Spread Spectrum devices, or 50 mW per 1 MHz, consistent with U-NII rules, should be required instead.

TI's Interest

Texas Instruments Incorporated is the world leader in digital signal processing and analog technologies, the semiconductor engines of the Internet age. The company's businesses also include materials and controls, and educational and productivity solutions. TI is headquartered in Dallas, Texas and has manufacturing or sales operations in more than 25 countries.

TI, through its acquisitions of Alantro Communications and Butterfly VLSI Ltd, is a leading developer of wireless local area networking technology, including both IEEE 802.11 and Bluetooth.

Texas Instruments' wireless networking group is establishing new benchmarks in the key areas of performance and cost-per-port - metrics against which the rest of the industry measures itself. Wireless connectivity allows seamless access from any location, at any time, and TI is committed to providing the enhancements and process technologies that enable rapid industry adoption. Through TI's Bluetooth and 802.11 technologies, one broadband connection into the home or office can bring personal information into every room connecting people, appliances, and phones - without the need for wires.

TI has developed the fastest, best-performing wireless local area network (WLAN) Wi-Fi, IEEE 802.11b-compliant chipset family on the market, offering a solution that doubles the data rate to 22 Mbps. Our innovations will enable new applications, such as high definition digital TV and streaming, high quality video, as well as the remote programming of "smart" appliances.

In addition, TI provides a two-chip solution that supports the latest Bluetooth specification for short-distance wireless communications. Among the many types of systems that can take advantage of the TI Bluetooth solution are digital cellular phones, Internet appliances, cordless phones, hands-free phone headsets, wireless home networks for PCs and PDAs, remote game and video controls, and PC-peripheral communications including printers, digital cameras and Internet audio players.

Frequency Hopping

The Commission has proposed to allow the use of as few as 15 hopping channels with a power limit of 125 mW at 2450 MHz, and has requested comments on whether it should be mandatory to employ adaptive frequency hopping in FHSS systems. NPRM, para. 13. We support the proposal to allow a reduced number of hopping frequencies because it will enhance the compatibility and coexistence of frequency hopping spread spectrum (FHSS) systems by reducing the amount of interference they will cause and suffer. Moreover, adaptive frequency hopping can improve the performance of Bluetooth devices employing it and thereby improve the coexistence of Bluetooth with other Part 15 wireless systems. However, adaptive frequency hopping should not be mandatory for FHSS, but should be encouraged.

TI/Butterfly's substantial experience with adaptive frequency hopping in the congested 915MHz license-exempt band, currently employed in the company's *WiNGs*™ wireless network FHSS communications protocol and products, has proven the effectiveness of this technique in avoiding interference and improving the coexistence performance, both for the FHSS system and for the other users of the band it may be coexisting with.

Use of as few as 15 hopping channels should be allowed. Due to the current requirement for at least 75 hopping channels, FHSS devices with 1 MHz channel bandwidth, such as Bluetooth devices, are forced to occupy most of the band, without being able to avoid other occupants of the band, and in particular wideband users, by dynamically adapting their hopping sequence, as allowed in Section 15.247(h). This is contrary to the situation in the other Section 15.247 bands, where the combination of the maximum allowed channel bandwidth with the minimal number of hopping channels, allows much more flexibility in the spectral occupancy of the FHSS system.

Because of the need for international harmonization of Bluetooth technology, the US requirement to use at least 75 hopping channels has adverse implications on a worldwide basis. Even in regions where fewer hopping channels are allowed with power levels as high as 20dBm, such as Europe and Japan, Bluetooth devices create interference over almost the entire band. See, for example, ETSI standard ETS 300 328 (Second edition, November 1966), section 5.1.1; see also, ARIB standard T-66.

By harmonizing the requirements with those of Europe and Japan, through the proposed reduction in hopping channels, the FCC would enable future revisions of the Bluetooth communications protocol, currently being developed, to coexist better with other users of the band worldwide. Since the development process for the next revision of the Bluetooth specifications is currently at an advanced stage, prompt action in this proceeding will allow these changes to be incorporated efficiently

Adaptive hopping should not be mandatory. If the Commission were to make adaptive hopping mandatory, it might have to define performance specifications such as how quickly must a hopset change in response to changes in interfering signals, etc. Otherwise, a manufacturer could claim, for example, that very slow changes to the hopset are adaptive changes, while they actually are too slow to effectively avoid other users of the band that the system may be coexisting with. It might have to define what level of interfering signal would be needed to cause a change in the hopset. But the level of interference that is tolerable might differ between various coexistence scenarios, or between different manufacturers' designs. A FHSS system might decide to accept tolerable interference from a system it is coexisting with (i.e., it decides not to replace any of its hopping channels), but this might cause noticeable interference to that other system. And contrariwise, Commission performance rules might force a FHSS system to change its hopset when not really necessary. These issues are currently under study by various industry groups. Rather than risk creating loopholes that are difficult to enforce, or detailed technical specifications that might have unintended adverse consequences in equipment performance, the Commission should encourage adaptive hopping but should allow it to be optional.

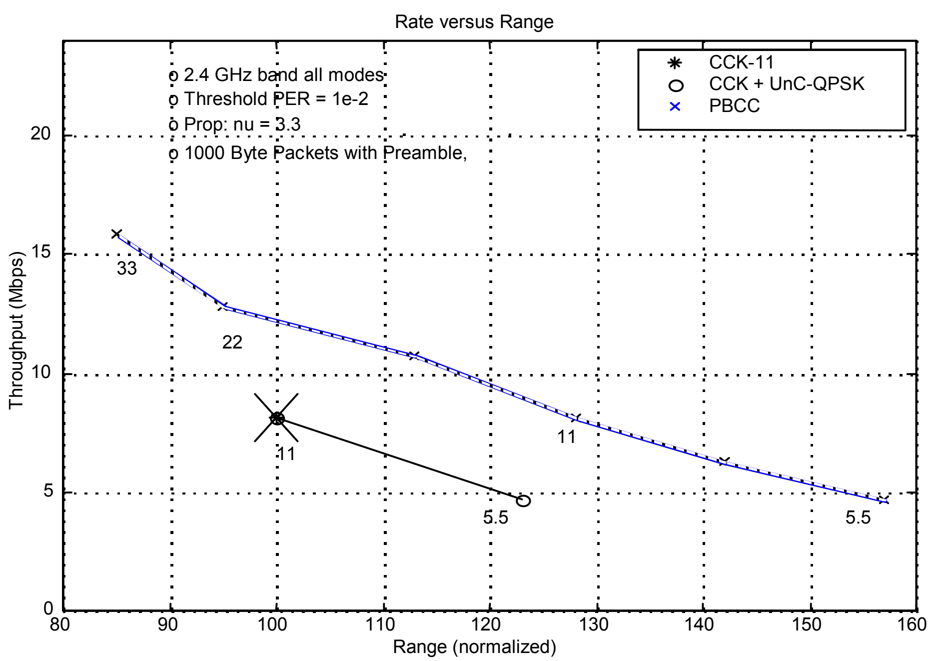
There are benefits in reducing the number of hopping channels, even without adaptive changes to the hopset and even by a "dumb" FHSS transmitter that does not sense interference as the basis to reduce its hopset. This is because a greater portion of the spectrum will be left clear for other users, both FHSS and other Part 15 users, and their performance will improve, either because they are equally dumb and avoid some frequencies by chance, or because they sense interference and intentionally avoid it.

Digital Transmission Systems

TI generally supports the Commission's proposal to establish a category of Digital Transmission System (DTS) devices under Part 15, and to impose only a limit on output power and power density that assures no greater interference than allowed by existing spread spectrum rules. However, the proposal to retain the power spectral density limit of 8 dBm per 3 kHz (33 dBm per 1 MHz) could in fact produce substantial interference and should be modified.

TI appreciates the Commission's leadership and forward thinking in promoting the development of new wireless technologies and removing regulatory barriers that have stood in the way of improved spectral efficiency for WLAN systems. The Commission has rightly proposed technology-neutral rules whose intent is to limit interference to the level that the current rules permit, without picking any single technology as a favorite. The NPRM and the associated waiver recognize that there may be numerous technologies that satisfy the proposed technical rules. NPRM, para. 26. But it is up to the marketplace and standards bodies to determine which of these technologies best meet the needs of the public. TI continues to believe that this approach serves the public interest better than a detailed regulatory regime that would allow some technologies but disallow others that might have similar interference and spectral occupancy properties.

The key to the Alantro/TI technology is a coding and modulation technique known as Packet Binary Convolutional Coding or PBCC. There are two flavors of PBCC in the current semiconductor products offered by TI. The first uses a 64 state BCC in conjunction with QPSK or BPSK modulation achieving a data rate of 11 and 5.5 Mbps, respectively. This form of PBCC is already a part of the IEEE 802.11b standard and operates at the same rates as the CCK flavors of the standard. The benefits of this "high performance mode" of the standard is that it operates with all existing 11b products and provides a larger range, on the order of 30%, as seen in the range versus rate figure. This benefit is achieved from the coding gain advantage (asymptotically 3 dB) of PBCC-11/5.5 over CCK-11/5.5.



The second flavor of PBCC combines a 256 state BCC with 8-PSK modulation. This combination of coding and modulation is fully backward compatible with IEEE 802.11b networks and offers higher throughput in the same environment as a CCK-11 network. Products using PBCC will have the same range at 22 Mbps as 11 Mbps CCK products. From a raw range versus rate calculation, one can see that the expected range is 95% of CCK-11.

From a transmission point of view, the PBCC waveforms are spectrally and temporally equivalent to the CCK waveforms. This means that radio technology developed for

CCK-only products will work without modification with PBCC enhanced products. Furthermore, from an interference generation point of view, the waveform characteristics will ensure the same level of interference as a CCK waveform. With PBCC enabled products, users can inter-operate with existing IEEE 802.11b networks with greater range with the same throughput, or greater throughput at the same range.

DTS Power Levels

The Commission seeks comment on the appropriate maximum power level for DTS devices. NPRM, para. 17. We support the same maximum 1 Watt output power limit that now applies to Direct Sequence Spread Spectrum (DSSS) devices. As the Commission has noted, DTS devices that comply with that output power limit will cause no more interference than DSSS devices. However, retaining the 8 dBm per 3 kHz power spectral density could result in substantial interference and this limit should therefore be decreased.

Regarding the 1 Watt output power limit, we expect the FCC will eliminate the category of DSSS and instead use DTS in the future to cover former DSSS devices. This is because, by eliminating the processing gain requirement (NPRM, para. 22), the Commission will in effect eliminate the criterion that established the DSSS category. Devices formerly authorized as DSSS will in the future be authorized as DTS. But it would be unfair and unjustified to decrease the power limit that has successfully been applied to the formerly-DSSS devices.

However, circumstances are different with respect to the power density limit. Historically, DSSS devices have had a bandwidth of 10 or 11 MHz, and thus have spread the 1 Watt maximum output power across that bandwidth. The power density limit of 8 dBm per 3 kHz would have allowed the 1 watt to be spread across as little as 500 kHz, but the DSSS processing gain requirement had the effect of requiring a much larger bandwidth. To our knowledge, there have never been any DSSS devices that spread 1 Watt across 500 kHz. But by removing the processing gain requirement and retaining the

8 dBm per 3 kHz power density limit, the Commission would be promoting the unintended consequence of relatively narrowband devices with 1 Watt of output power.

Consequently, we propose that the power density limit that was employed in practice for DSSS devices, 1 Watt per 10 MHz or 100 mW per 1 MHz, be employed under the new rules for DTS devices. In the alternative, we would also support the U-NII limit of 17 dBm (50 mW) per 1 MHz, discussed below.

In the future, the Commission may also want to consider whether there is a need for a temporal power density limit. The Commission is familiar with the temporal peak-to-average properties of digital transmission technologies, for example in its consideration of digital television transmission technologies.[1] At this point in time, there is no record indicating that a limit is needed for temporal peak-to-average ratios, but we mention this issue so that as the technology evolves, it may be included in future proceedings.

The U-NII Alternative

The Commission has proposed, as an alternative to creating the DTS category of Part 15 devices, that instead the U-NII rules now applicable to the 5725-5825 MHz band might be employed at 915 and 2450 MHz. NPRM, para. 18. According to Section 15.405(a)(3), U-NII devices in this band must comply with a 1 Watt output power limit and a power density limit of 17 dBm (50 mW) in any 1 MHz, with a 26 dBc emission bandwidth. Thus, a 1 Watt U-NII device would have to occupy 20 MHz. TI would have no problem accepting this power density limit for DTS devices.

[1] See, for example, DTV Report On COFDM and 8-VSB Performance, FCC OET Report 99-2, September 30, 1999, at pages 10, 20 and 23.

Conclusion

In light of these considerations, the Commission should adopt the proposal to allow as few as 15 hopping frequencies at 2450 MHz with a power limit of 125 mW, but without a requirement for adaptive hopping. The Commission should establish a category of Digital Transmission System devices under Part 15 with a maximum output power of 1 Watt and a power spectral density limit of either 50 mW or 100 mW per 1 MHz.

Respectfully submitted,

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